INITIAL STOCK ASSESSMENTS OF THE SOUTHERN HEMISPHERE HUMPBACK WHALE BREEDING SUB-STOCK B1

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ABSTRACT

Initial Bayesian stock assessment results for humpback breeding sub-stock B1 are presented. These suggest this population presently to be within the range of 60-90% of its pre-exploitation size in terms of point estimates.

KEYWORDS: HUMPBACK WHALES, BAYESIAN ASSESSMENT

INTRODUCTION

The Southern Hemisphere humpback whale stock B, which winters off west Africa, is currently divided into two sub-stocks:

Sub-stock B1 – Gabon

Sub-stock B2 – west South Africa, Namibia, Angola.

The exact boundaries between these two- sub-stocks is unclear. This report aims to provide some preliminary stock assessment results for sub-stock B1 whales in the interests of advancing discussion. As there is as yet no abundance estimate available for sub-stock B2, this is not assessed here.

DATA

Historic Catch data

There are two sources of historic catch data that relate to breeding sub-stock B1.

i) Catches north of 40°S - those from "Congo" and 50% of "Congo/Angola" categories from Allison's database (Allison pers. commn).

ii) Catches south of 40°S - this series refers to catches recorded for 20°W-10°E and will thus include both B1 and B2 whales. Table 1a and Figure 1 report these three historic catch series. Three possible simple options are explored here for splitting this combined catch series. These are that to assume that either 25%, 50% or 75% of this combined series can be attributed to sub-stock B1.

Absolute abundance data

The absolute abundance data used in these analyses are presented in Table 1b. For breeding sub-stock B1, estimates from Collins *et al.* (2006) are used. Here, both the estimates of 5317 (CV = 0.21) and 5766 (CV=0.20) for the 2002 season are considered. These estimates of population abundance have been obtained using individual identification photographs and genetic multi-locus genotypes from mark recapture studies.

Trend information

No trend data appear to be available for the breeding grounds. IDCR/SOWER survey estimates provided by Branch (2006) are available for feeding ground II (20°W-10°E) for 1980, 1986 and 1995 – see Table 1c. These trend data clearly relate to both B1 and B2 animals. The estimates have very large associated CVs, so that little weight is afforded them in these analyses.

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METHODS

Simple population modelling approach

A simple Bayesian stock assessment modelling approach is used here to assess sub-stock B1. This modelling approach is identical to that used for other breeding stocks and is described fully in Johnston *et al*. (2007), and applied to breeding stocks A (Zerbini *et al.* 2006), G (Johnston *et al.* 2007), and sub-stocks C1 and C2+3 (Johnston and Butterworth 2007).

Here the catches from the feeding grounds (catches south of 40°S) are apportioned either 25%, 50% or 75% to sub-stock B1. The IDCR/SOWER survey data are used as trend data. Four different priors for *r* are used:

$r \sim U[0; 0.106]$,

$r \sim$ post (BS A) where the posterior of the *r* parameter from breeding stock A (Zerbini *et al.* 2006) is used,

$r \sim$ post (BC C1) where the posterior of the *r* parameter from simple single assessment of breeding stock C1 (Johnston and Butterworth 2007) is used, and

$r \sim$ post (BS D) where the posterior of the *r* parameter from breeding stock D (Johnston and Butterworth 2006) is used (note that this posterior corresponds to the BS D model application for which an upper bound of 0.106 for *r* was in place).

N_{min} Constraint

An N_{min} constraint of 368 whales is imposed. This value is 4 times the number of haplotypes (92) identified by Rosenbaum *et al.* (2006) for this stock.

RESULTS AND DISCUSSION

Tables 2a and b report a numbers of assessment results for breeding sub-stock B1. These are shown as variations on a Reference case based upon an abundance estimate of 5317 in 2002, the post (BS C1) prior for *r*, and no use of the IDCR trend information. Generally these suggest a resource currently increased to within the range of 60-90% of its pre-exploitation size in terms of point estimates. Note that the *r* priors dominate the estimation, with addition of the IDCR trend information having little impact.

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Table 1a: Historic catches from sub-stock B1 from the breeding grounds and for the combined B1+2 sub-stocks from the feeding grounds (Allison, pers. commn).

Season	B1 Breeding ground catches	B1+2 Feeding ground catches	Season	B1 Breeding ground catches	B1+2 Feeding ground catches
1900-1911	0	0	1951	1105	428
1912	418	0	1952	265	202
1913	2227	0	1953	0	102
1914	1843	0	1954	0	318
1915	0	0	1955	0	144
1916	0	0	1956	0	96
1917	0	0	1957	0	62
1918	0	0	1958	0	88
1919	0	0	1959	161	62
1920	0	0	1960	0	118
1921	0	0	1961	0	18
1922	613	0	1962	0	14
1923	685	0	1963	0	2
1924	519	0	1964	0	0
1925	756	0	1965	0	892
1926	321	0	1966	0	148
1927	0	0	1967	0	366
1928	0	0	1968	0	0
1929	0	18	1969	0	0
1930	578	64	1970	0	0
1931	0	4	1971	0	0
1932	0	18	1972	0	2
1933	0	86			
1934	362	38			
1935	894	300			
1936	595	250			
1937	150	188			
1938	0	0			
1939	0	0			
1940	0	242			
1941	0	0			
1942	0	0			
1943	0	0			
1944	0	0			
1945	0	0			
1946	0	2			
1947	0	2			
1948	0	84			
1949	1356	466			
1950	1404	228			

Table 1b

Absolute abundance estimates used for sub-stock B1 assessments.

Year	**Breeding Stock B**	
		Source
2002	5317 (CV = 0.21)	Collins *et al.* (2006)
2002	5766 (CV = 0.20)	Collins *et al.* (2006)

Table 1c

IDCR/SOWER estimates for the breeding grounds over 20°W-10°E (Branch 2006) for breeding stock B, adjusted to correspond to the same northern boundary for comparability, that are used to provide information on population trend.

Year	**Breeding Stock B** (20°W-10°E)
1980	692 (CV = 0.84)
1986	70 (CV = 0.63)
1995	595 (CV = 0.51)

Table 2a

Breeding sub-stock **B1** model estimates. Posterior medians with the 5th and 95th percentiles (in parentheses) are reported. Specifications that differ from those of the RC are shown in bold.

	RC: Model 1	**Model 2**
Historic Catch	50% of feeding ground catches	50% of feeding ground catches
Recent abundance	5317 in 2002	5317 in 2002
Trend information	None	**IDCR**
***r* prior**	*r* ~ post (BS C1)	**U[0; 0.106]**
r	0.068 [0.046; 0.089]	0.048 [0.006; 0.094]
K	8033 [6979; 9947]	9718 [6844; 19376]
N_{min}	736 [407; 2458]	1405 [430; 5156]
N_{2006}	6301 [4874; 7906]	6163 [4314; 7978]
N_{min}/K	0.091 [0.055; 0.256]	0.140 [0.060; 0.290]
N_{2006}/K	0.787 [0.551; 0.991]	0.623 [0.270; 0.986]
N_{2020}/K	0.973 [0.832; 1.000]	0.872 [0.299; 1.000]
N_{2040}/K	0.999 [0.981; 1.000]	0.985 [0.335; 1.000]
	Model 3	**Model 4**
Historic Catch	50% of feeding ground catches	50% of feeding ground catches
Recent abundance	5317 in 2002	5317 in 2002
Trend information	**IDCR**	None
***r* prior**	*r* ~ post (BS C1)	***r* ~ post (BS A)**
r	0.069 [0.045; 0.089]	0.063 [0.025; 0.087]
K	8031 [6979; 9996]	8382 [7063; 13014]
N_{min}	714 [402; 2135]	868 [412; 3341]
N_{2006}	6252 [4838; 7841]	6230 [4676; 7949]
N_{min}/K	0.088 [0.054; 0.236]	0.101 [0.056; 0.276]
N_{2006}/K	0.783 [0.543; 0.987]	0.740 [0.418; 0.985]
N_{2020}/K	0.973 [0.826; 0.999]	0.957 [0.578; 0.999]
N_{2040}/K	0.999 [0.979; 1.000]	0.998 [0.783; 1.000]
	Model 5	**Model 6**
Historic Catch	50% of feeding ground catches	50% of feeding ground catches
Recent abundance	5317 in 2002	**5766 in 2002**
Trend information	None	None
***r* prior**	***r* ~ post (BS D)**	*r* ~ post (BS C1)
r	0.082 [0.033; 0.104]	0.070 [0.045; 0.092]
K	7380 [6449; 11602]	7995 [6901; 10102]
N_{min}	690 [387; 6198]	837 [419, 4726]
N_{2006}	6391 [4989; 7950]	6579 [5218; 8315]
N_{min}/K	0.091 [0.055; 0.802]	0.103 [0.058; 0.602]
N_{2006}/K	0.906 [0.473; 0.999]	0.838 [0.585; 1.000]
N_{2020}/K	0.995 [0.688; 1.000]	0.983 [0.851; 1.000]
N_{2040}/K	1.000 [0.911; 1.000]	1.000 [0.983; 1.000]

Table 2b

Breeding sub-stock **B1** model estimates. Posterior medians with the 5th and 95th percentiles (in parentheses) are reported.

	RC: Model 1	**Model 6**	**Model 7**
Historic Catch	50% of feeding ground catches	**25% of feeding ground catches**	**75% of feeding ground catches**
Recent abundance	5317 in 2002	5317 in 2002	5317 in 2002
Trend information	NONE	NONE	NONE
***r* prior**	r ~ post (BS C1)	r ~ post (BS C1)	r ~ post (BS C1)
r	0.068 [0.046; 0.089]	0.069 [0.045; 0.090]	0.069 [0.045; 0.089]
K	8033 [6979; 9947]	7701 [6735; 9491]	8389 [7255; 10562]
N_{min}	736 [407; 2458]	758 [408; 4198]	719 [404; 2005]
N_{2006}	6301 [4874; 7906]	6194 [4727; 7725]	6406 [4878; 7974]
N_{min}/K	0.091 [0.055; 0.256]	0.097 [0.057; 0.564]	0.085 [0.052; 0.205]
N_{2006}/K	0.787 [0.551; 0.991]	0.814 [0.562; 0.999]	0.766 [0.516; 0.982]
N_{2020}/K	0.973 [0.832; 1.000]	0.978 [0.841; 1.000]	0.969 [0.795; 0.999]
N_{2040}/K	0.999 [0.981; 1.000]	0.999 [0.982; 1.000]	0.999 [0.973; 1.000]

Figure 1: Historic catch series for sub-stock B1 feeding ground and the B (i.e. B1+B2) feeding ground catches.

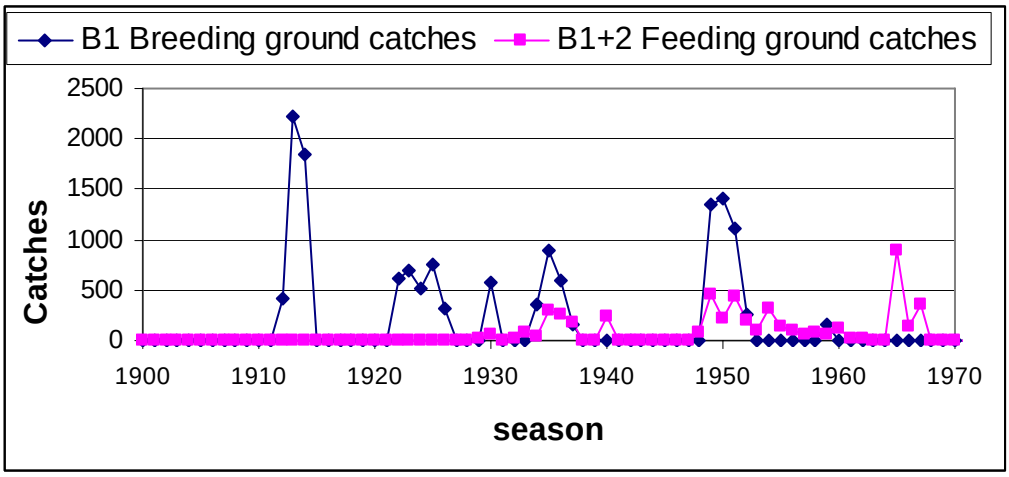
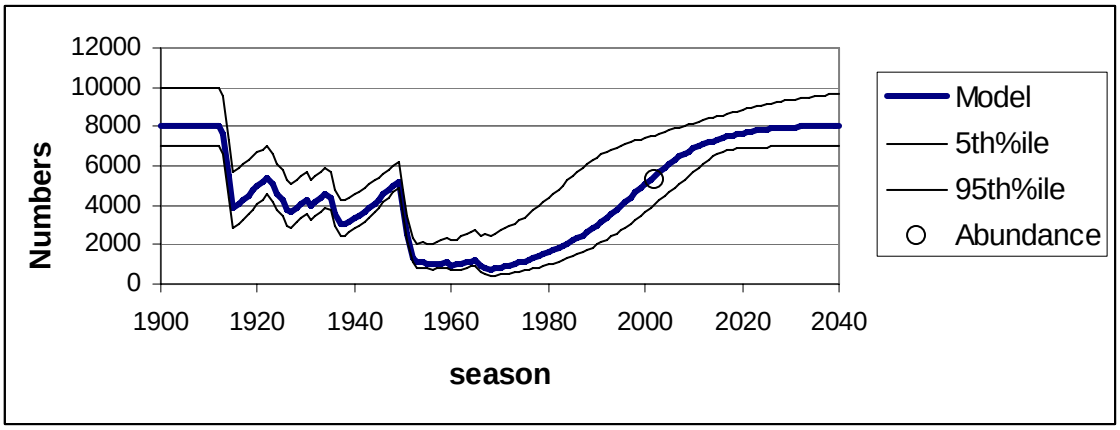
Figure 2: Model 4 population abundance estimates for sub-stock B1. Medians with 5th and 95th percentiles shown. The observed population abundance estimate is shown as a circle on the plot.